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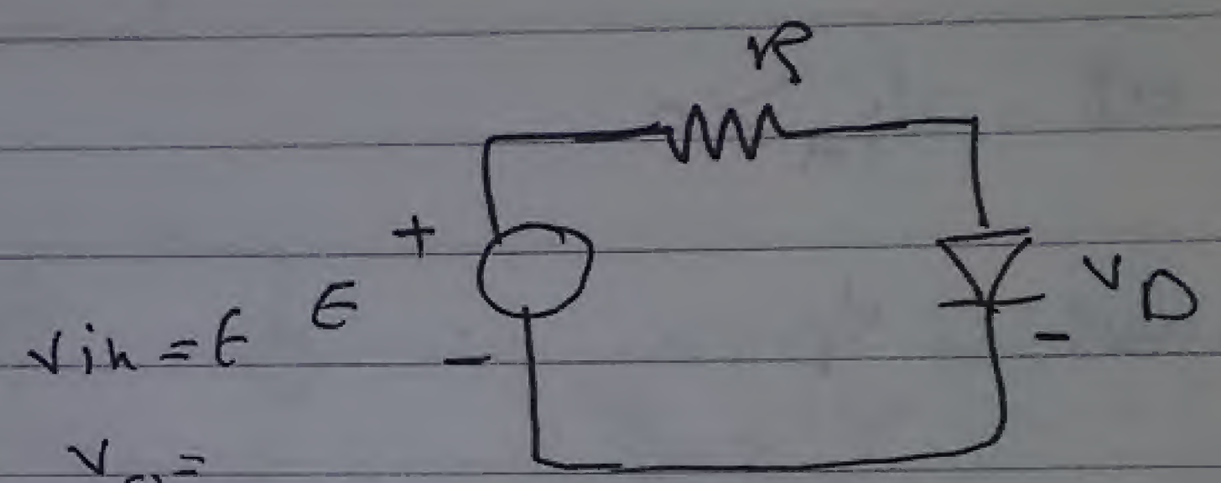
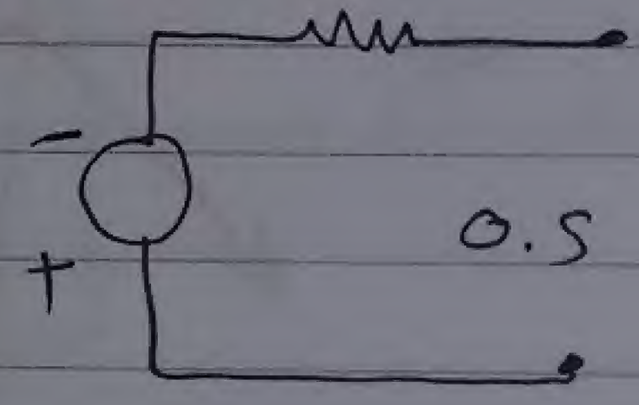
* Application

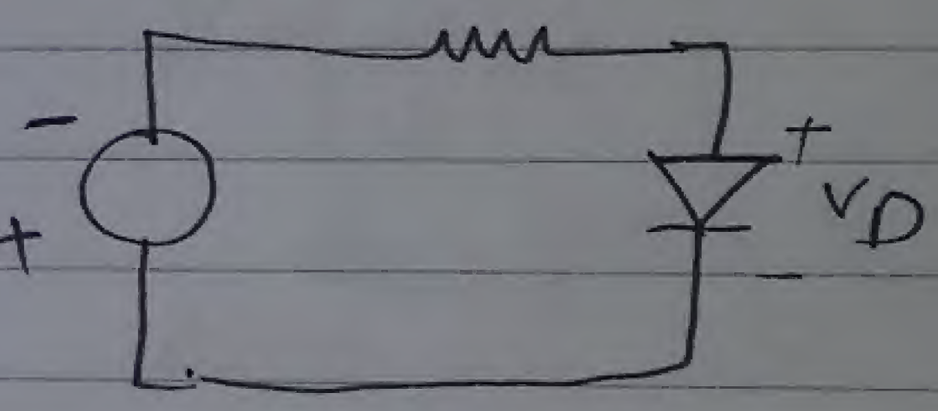
1) Rectification 2) NOR/NOR logic gates
3) Resistor Diode circuits

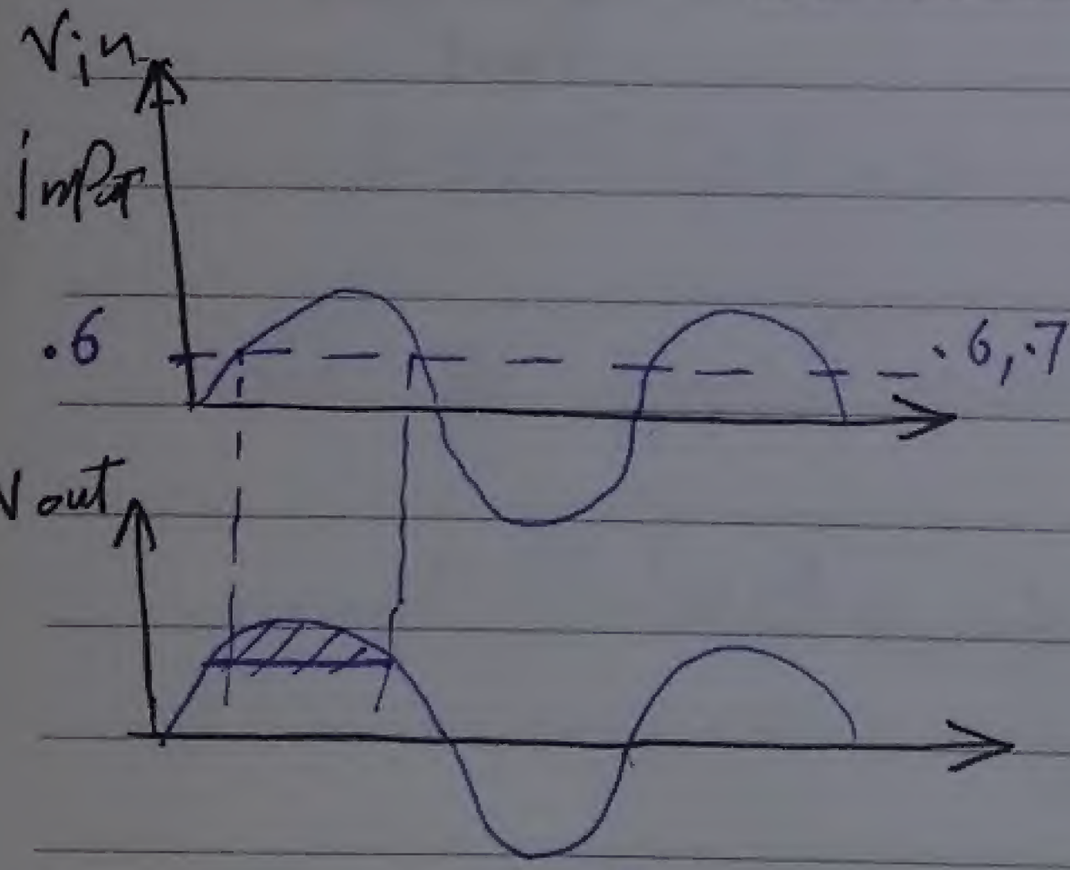
$V_D = Zero$

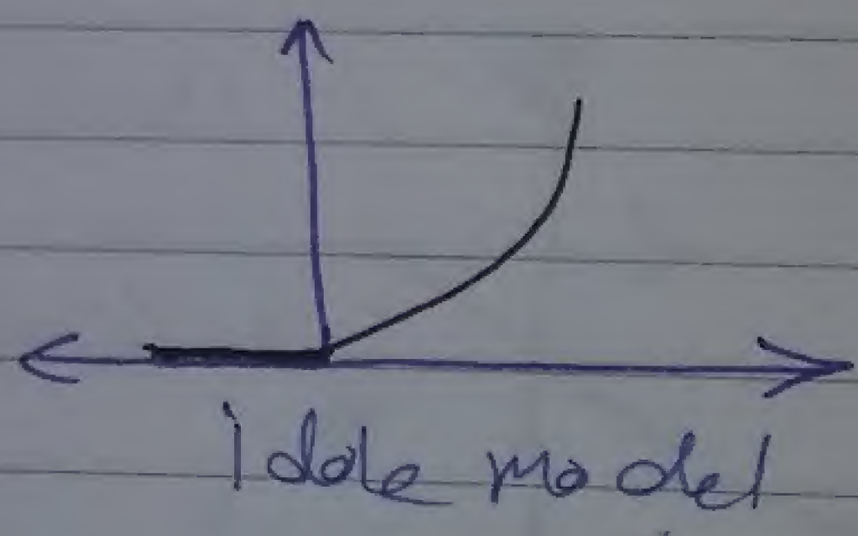


$V_o = Zero$









if $V_p \uparrow \Rightarrow V_{out} \downarrow$

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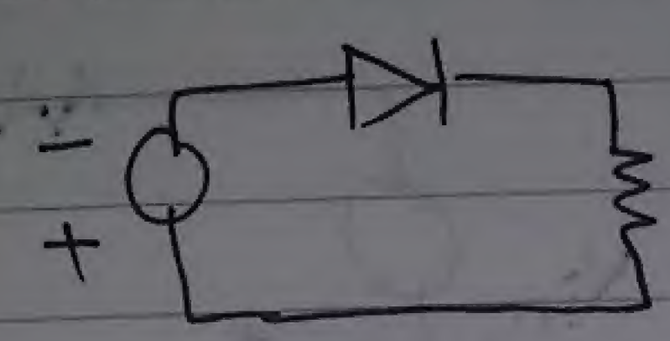
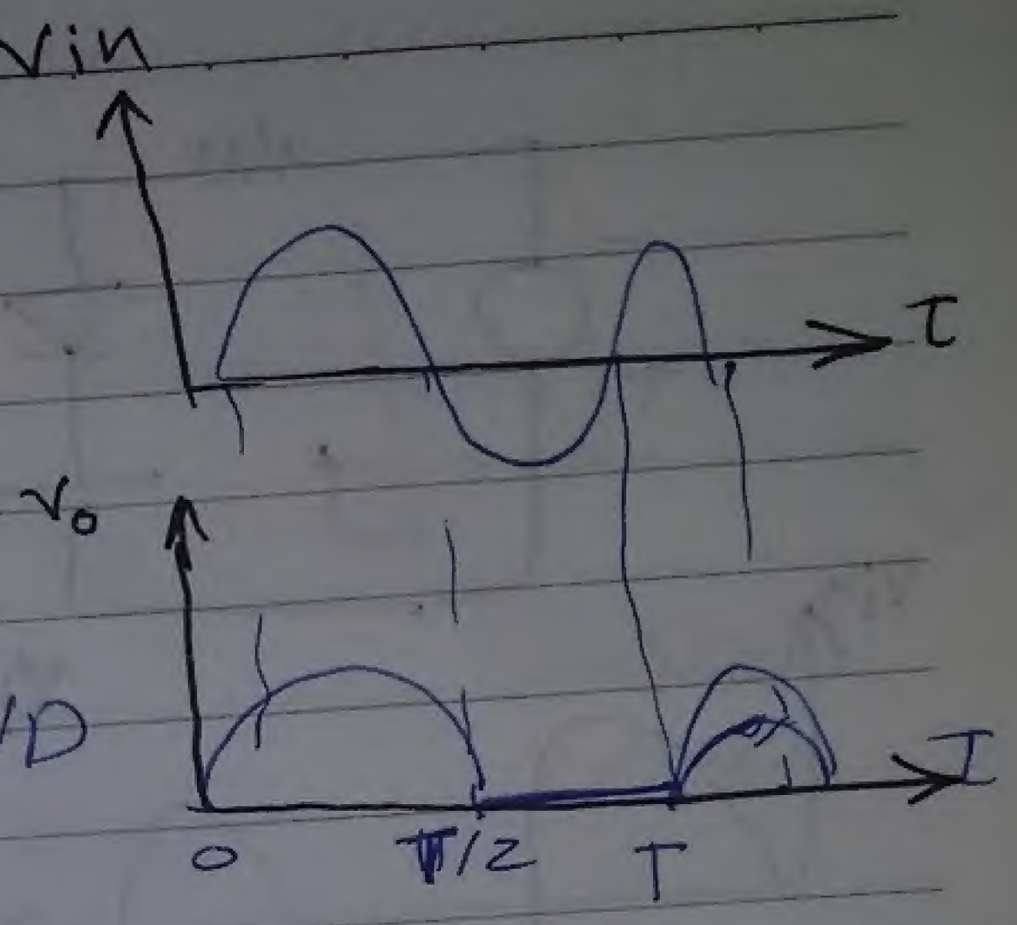




Half wave Rectifier

$E = V_p + fR$

$E = V_p + V_o$

$E = V_o$ at $V_p = 0$ Ideal

$V_{in} = V_p \cos \omega t$ $\omega =$

$V_o = V_p \cdot \cos \omega t$ $0 < t < \frac{T}{2}$ complete cycle

$V_o = 0$

$$\Rightarrow V_{out\ average} = \frac{1}{T} \int_0^{\pi/2} V_{out}(t)\, dt = \frac{1}{T} \int_0^{\pi/2} V_p \cos \omega t$$

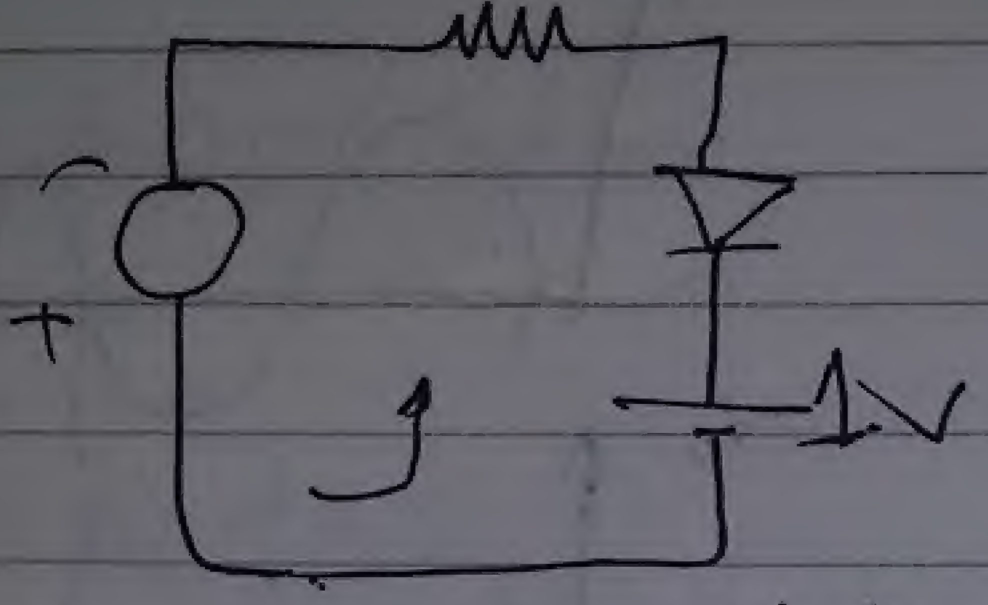
$$\therefore V_{out} = \frac{V_p}{\omega \cdot T} (\sin \omega T) \Big|_0^{\pi/2} \Rightarrow$$

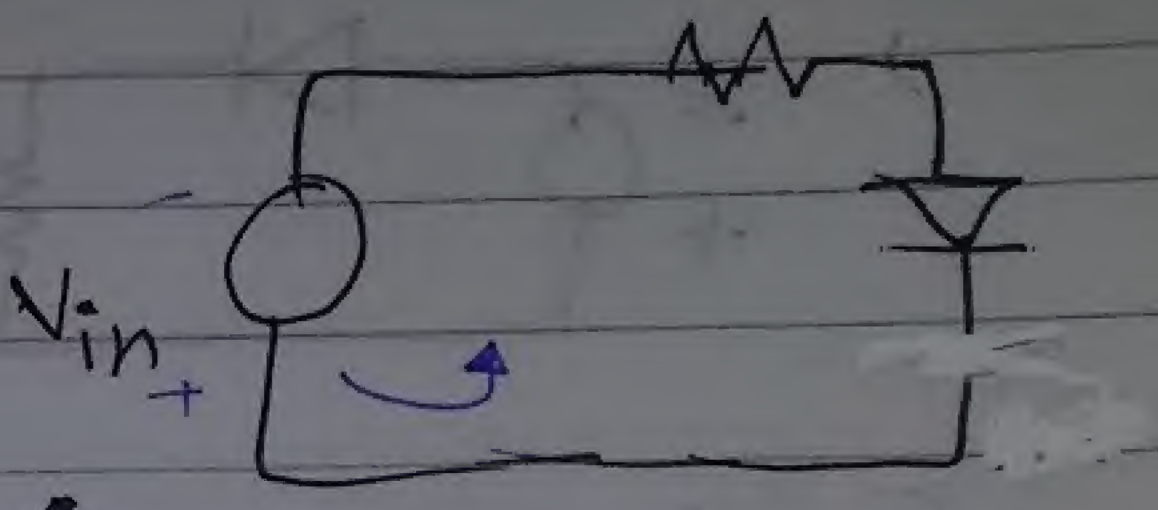
$$V_{out} = \frac{1}{T} \int_0^{\pi/2} V_p \sin \omega T = \frac{-V_p}{\omega t} (\cos \omega t) \Big|_0^{\pi/2}$$

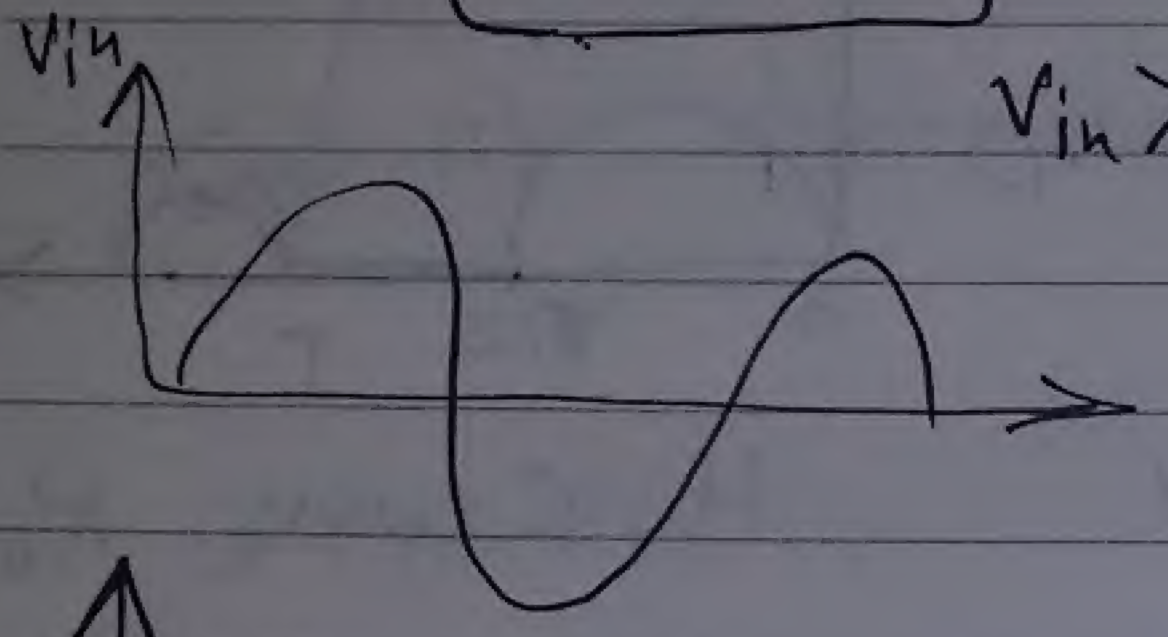
$V_{ave} = .318\, V_p = 30\ \%$

من أقصى قيمة للداخل .

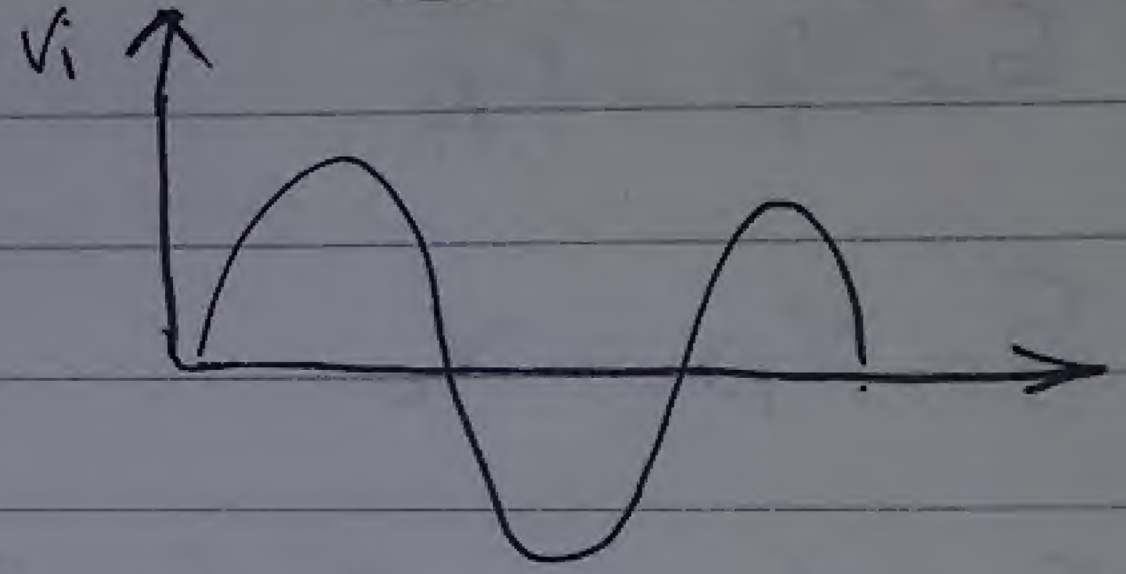
∴ الدايود هيخلي 30% وطلوعه AC

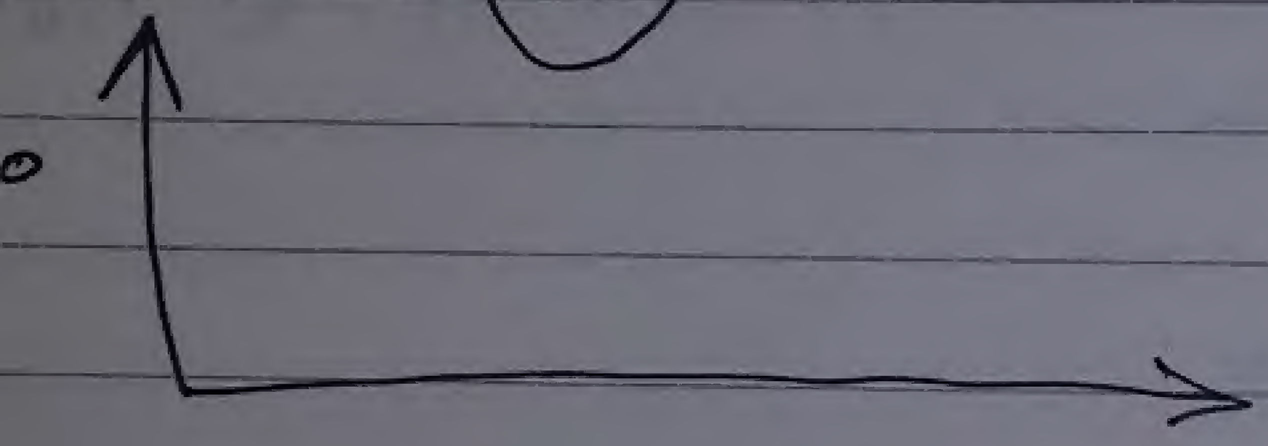


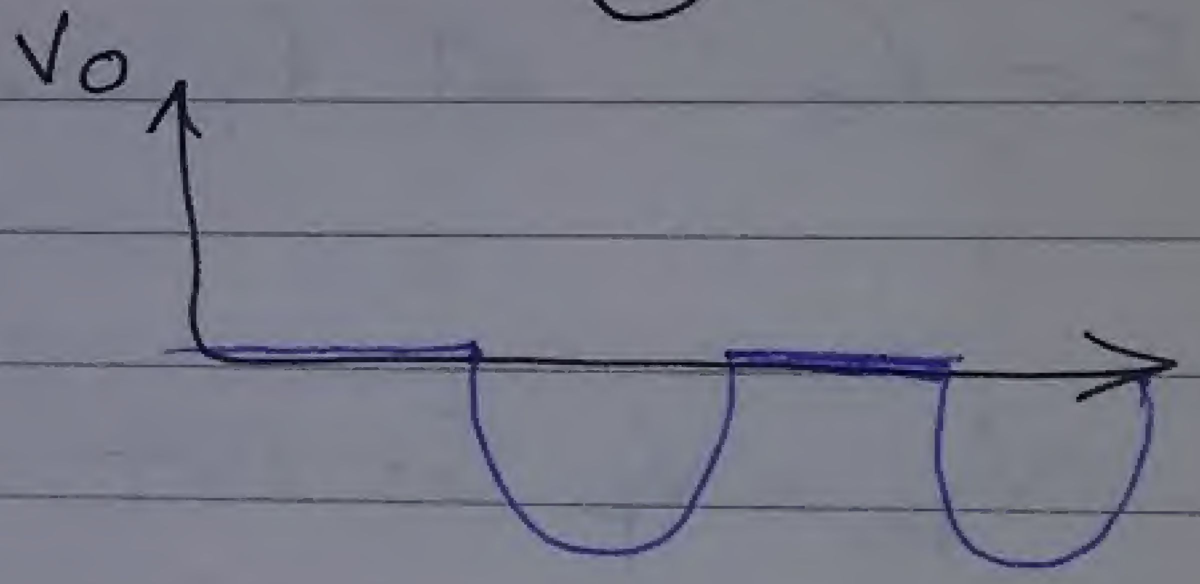




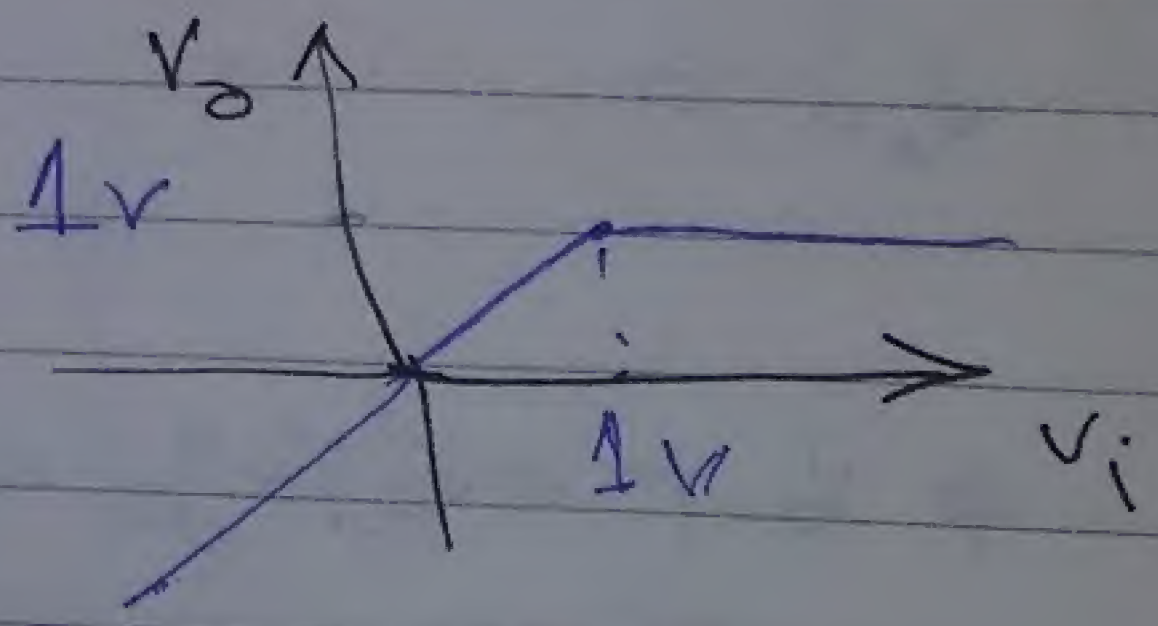
$V_{in} > 1v$







لما نحط بطارية 1 فولت : الدايرة مش هتوصل الا لما يكون $V_{in} > 1v$



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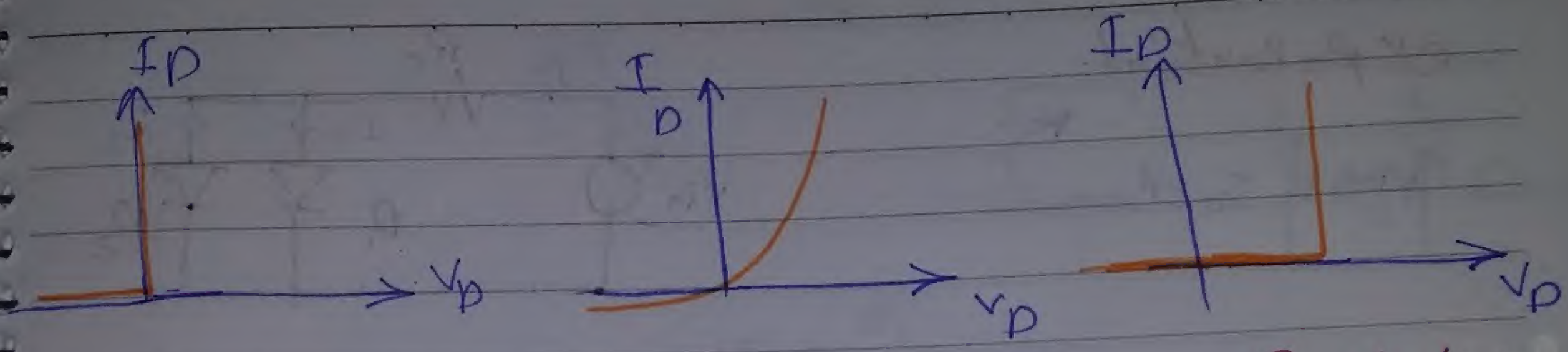
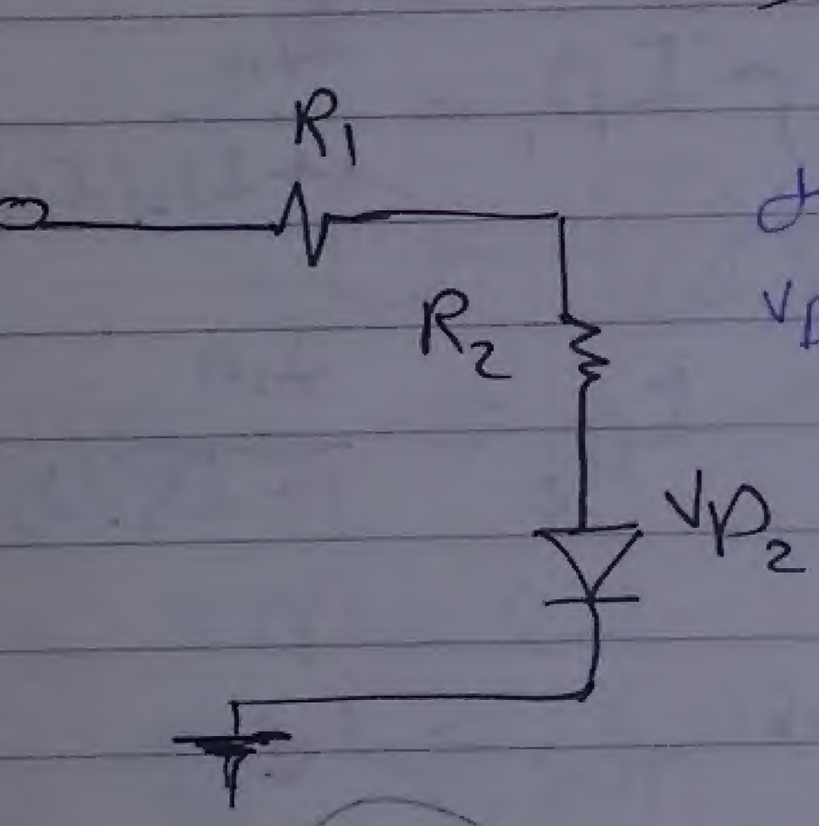


ideal

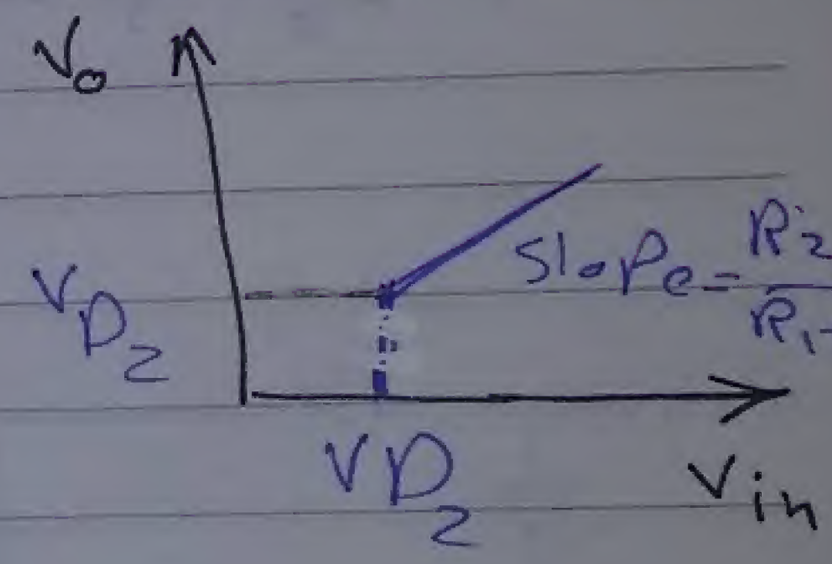
exponential

Constat Voltage.

$I_D = I_S \exp^{V_D/kT}$



الدايود مسكر طبيعي
$V_{D_2} < V_{in}$ الا لما يكبر

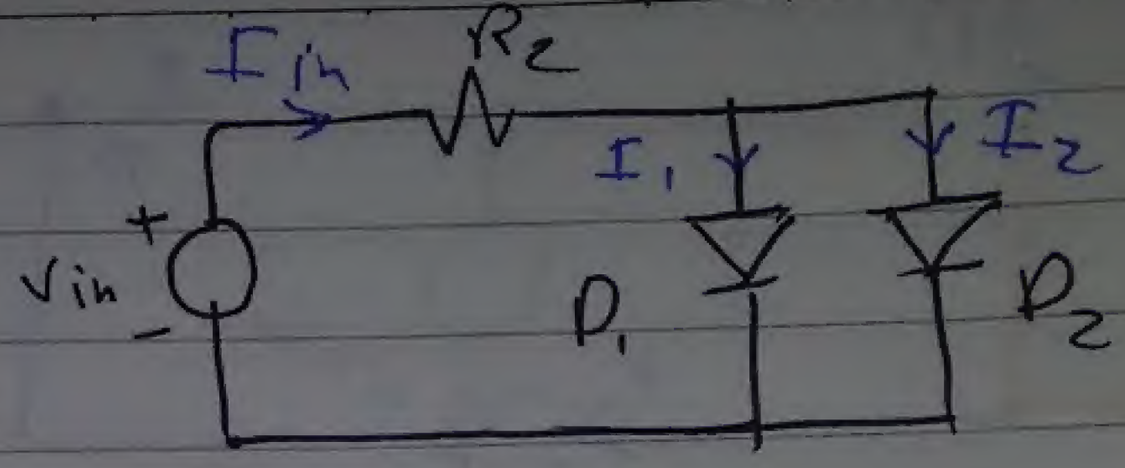


$V_{out} = V_{in} * \frac{R_2}{R_1+R_2}$ ⟶ Slope $\Rightarrow \frac{V_{in}-V_o}{R_1} = \frac{V_o - V_D}{R_2}$

$$\therefore V_{out} = \frac{\frac{R_2}{R_1} V_{in} + V_{D_2}}{1 + \frac{R_2}{R_1}}$$

exponential.

Cross Section



$$\Rightarrow I_{in} = I_{D_1} + I_{D_2}$$

$$V_{D_1} = V_T \ln \frac{I_{D_1}}{I_{S_1}}$$

$$V_{D_2} = V_T \ln \frac{I_{D_2}}{I_{S_2}}$$

$$\frac{I_{D_1}}{I_{S_1}} = \frac{I_{D_2}}{I_{S_2}}$$

Cross Solutions

$$I_{D_1} = \frac{I_{in}}{1 + I_{S_2}/I_{S_1}}$$

$$I_{D_2} = \frac{I_{in}}{1 + I_{S_1}/I_{S_2}}$$

$\Leftarrow$ لو كان الـ Cross متساوي

$$I_{S_1} = I_{S_2}$$

$$\therefore I_{D_1} = \frac{I_{in}}{1+1} = \frac{I_{in}}{2}$$

$$I_{D_2} = \frac{I_{in}}{2}$$

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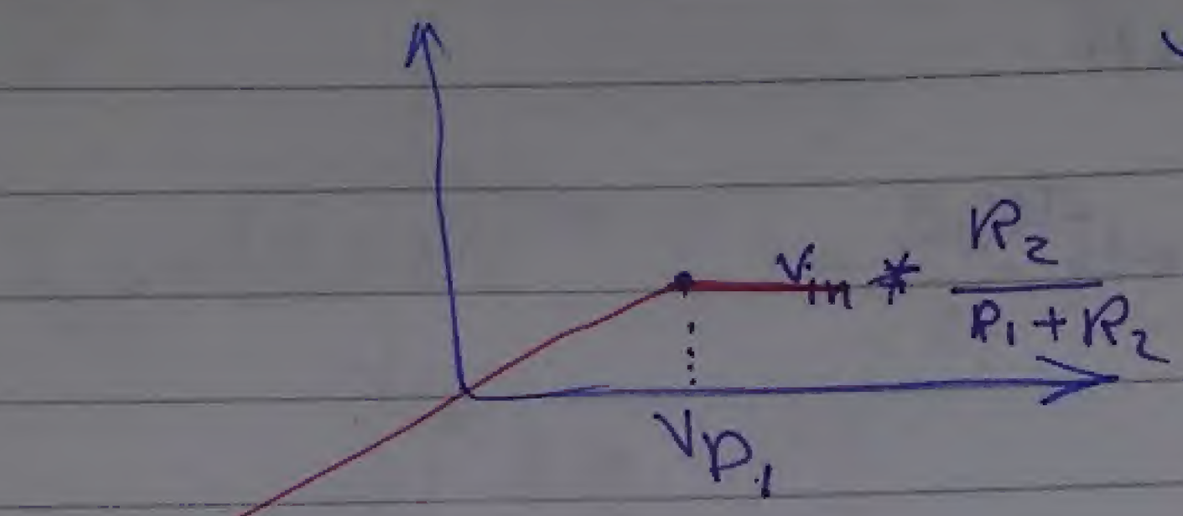
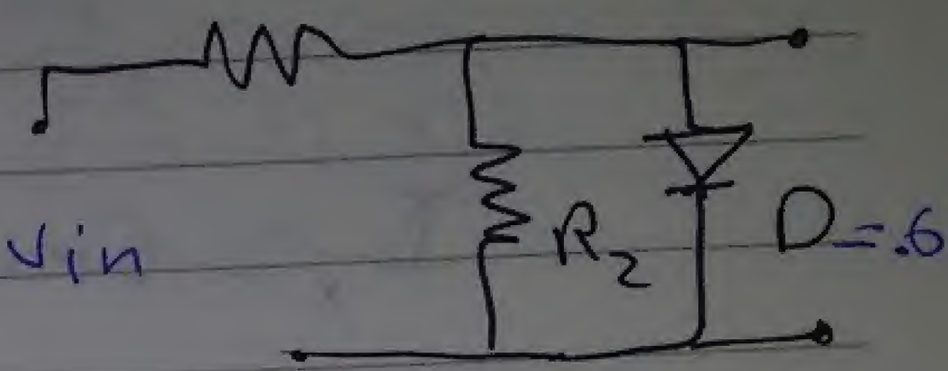
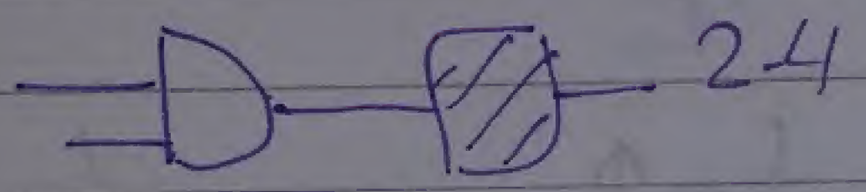
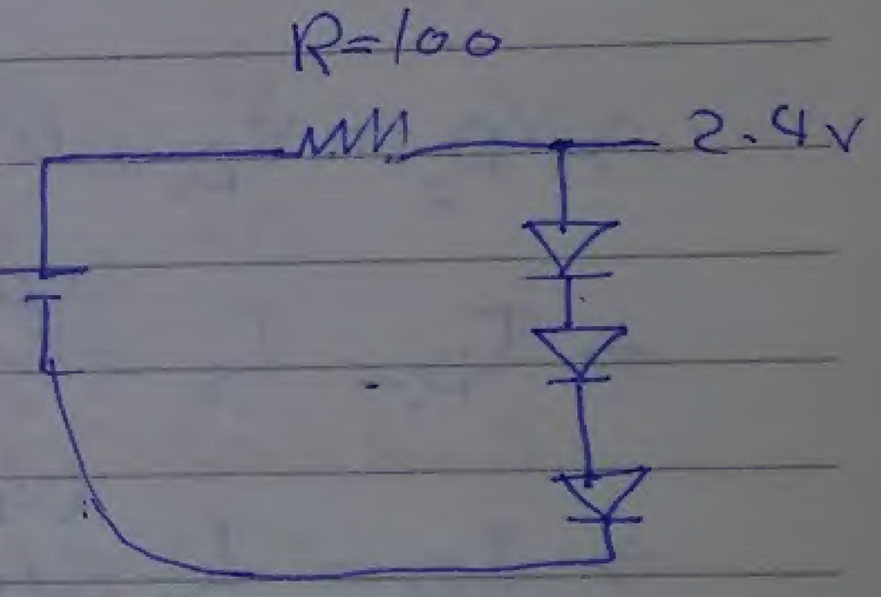
$$V_{D_0} = V_{in} \frac{R_2}{R_1 + R_2}$$





2.4 شاحنة 3.V عايزين نحرق منه صح





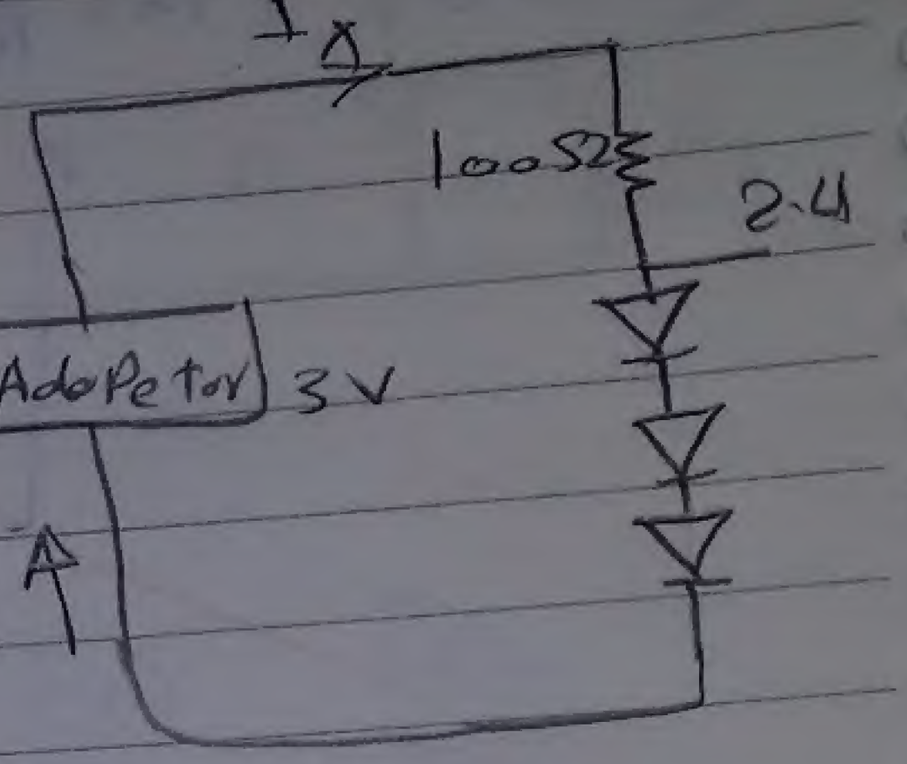
$V_D = .8$

$\therefore 3V_D = 2.4$

$\Rightarrow I_R = \frac{3 - 2.4}{100} = \frac{.6}{100} = 6m.A$

$I_X = I_S \exp\left(\frac{V_D}{V_T}\right)$ $\quad \Rightarrow V_D = .8$

$V_T = 26mV$



$I_x = 6m.A$

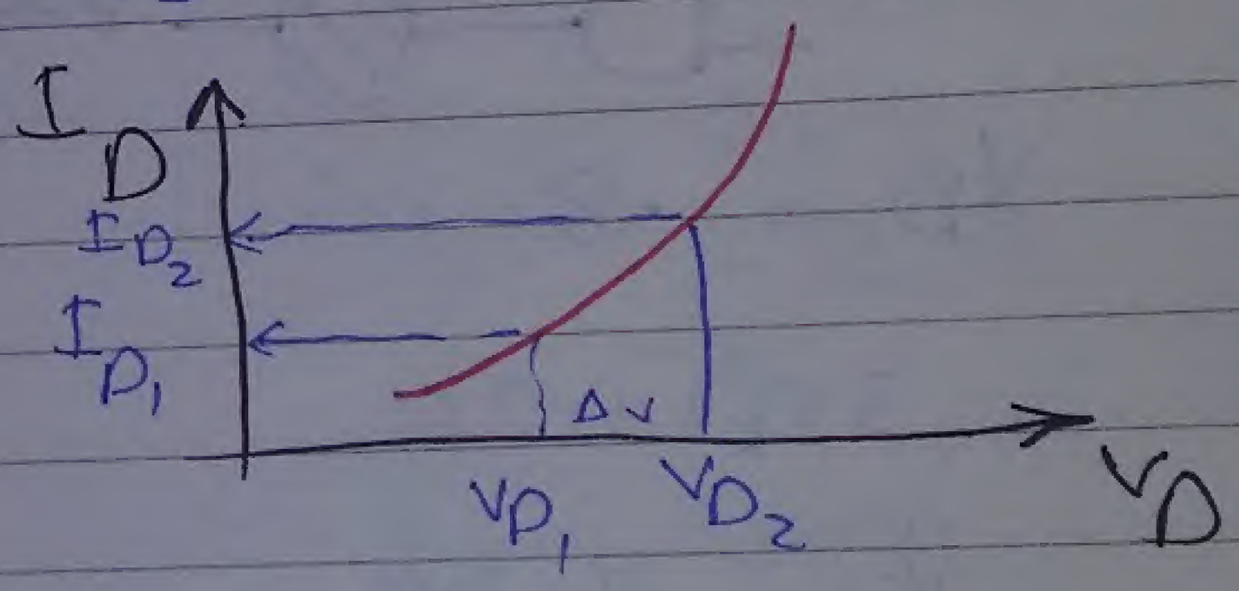
$I_S = 2.6 * 10^{-16}$.

"دايما فيه صغيره بكره"

$V_D = V_T \ln \frac{I_D}{I_S}$

لدايود واحد بس

$\Rightarrow V_D = 3 V_T \ln(\frac{I_D}{I_S})$



$\Rightarrow V_{D_2} = -V_{D_1} + \Delta V$

$\Rightarrow I_{D_1} = I_S \exp^{(V_{D_1}/V_T)}$

$\Rightarrow I_{D_2} = I_S \exp^{(V_{D_2}/V_T)}$

$\Rightarrow I_{D_2} = I_S \exp^{((V_{D_1}+\Delta V)/V_T)}$

$\therefore I_{D_2} = I_S \exp^{V_{D_1}/V_T} \cdot \exp^{(\Delta V/V_T)}$

$\Delta V <<< V_T \rightarrow 26m.V \Rightarrow$ Small Signal mode

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Note

$e^{-x} = 1 + x$

$$\Rightarrow I_{D_2} = I_S e^{V_{D_1}/V_T} * e^{\Delta V/V_T}$$

$$\therefore I_{D_2} = I_S e^{V_{D_1}/V_T} \left(1 + \frac{\Delta V}{V_T}\right)$$

$$I_{D_2} = I_{D_1} + I_{D_1} \frac{\Delta V}{V_T} \quad \therefore I_{D_2} - I_{D_1} = I_{D_1} \frac{\Delta V}{V_T}$$

$$\therefore \Delta I_D = I_{D_1} \frac{\Delta V}{V_T}$$

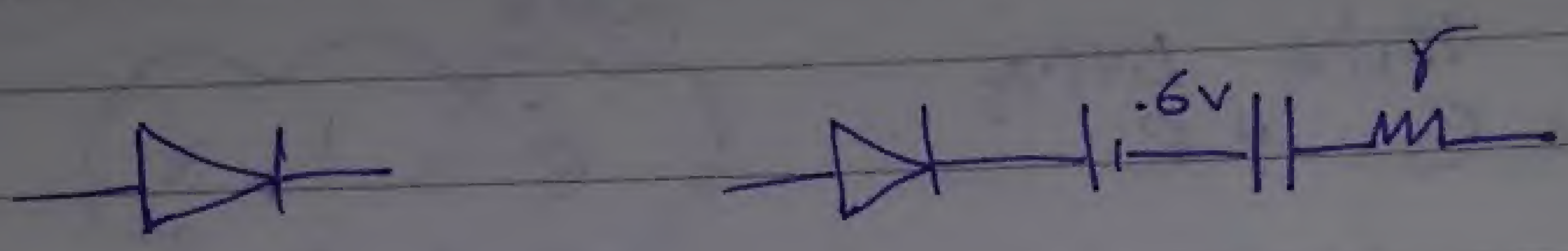
$$\Rightarrow \Delta I_D = \frac{I_D}{V_T} \Delta V_D \quad \Rightarrow \frac{\Delta V_D}{\Delta I_D} = \frac{V_T}{I_D}$$

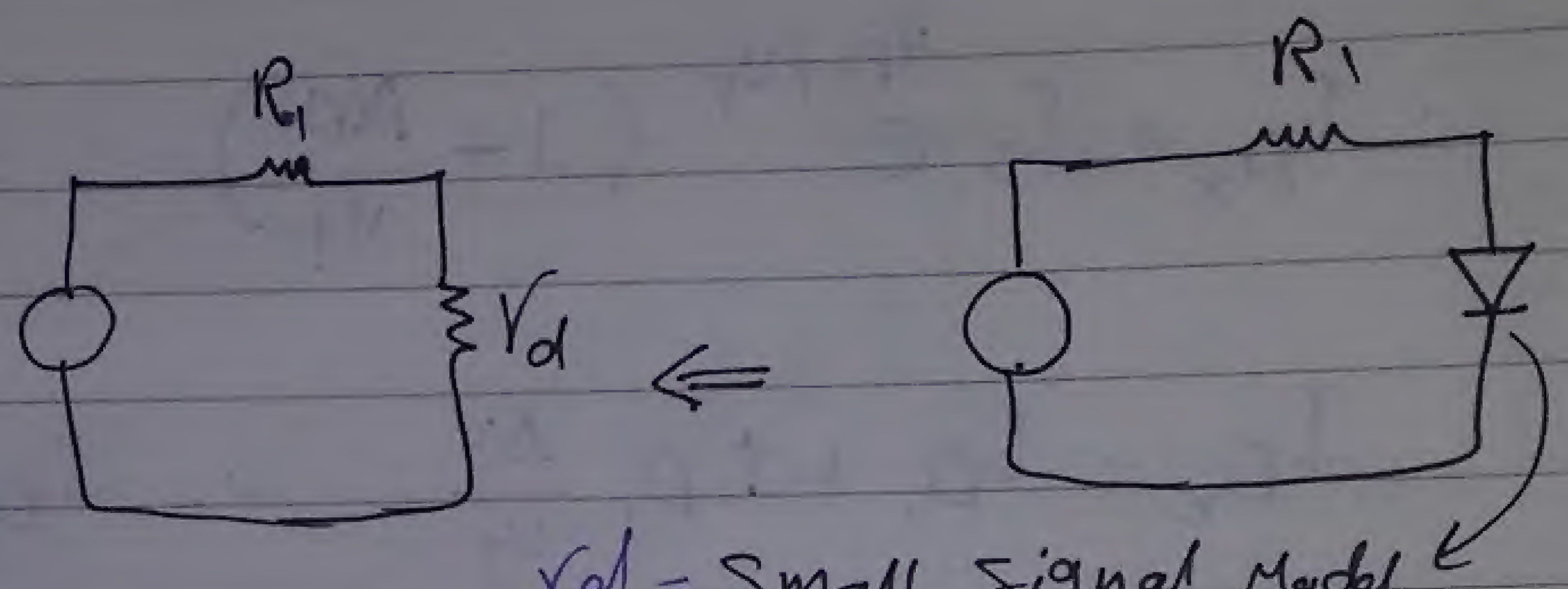
$$\therefore R_D = \frac{V_T}{I_D} \Rightarrow \text{Dynamic Resistance.}$$

ex:- $\Rightarrow I_D = 1\,m.A$ Current Changes of V_D Change by 1m.V

$$\therefore \frac{\Delta V_D}{\Delta I_D} = \frac{V_T}{I_D} \Rightarrow \frac{1mV}{\Delta I_D} = \frac{26mV}{1m.A}$$

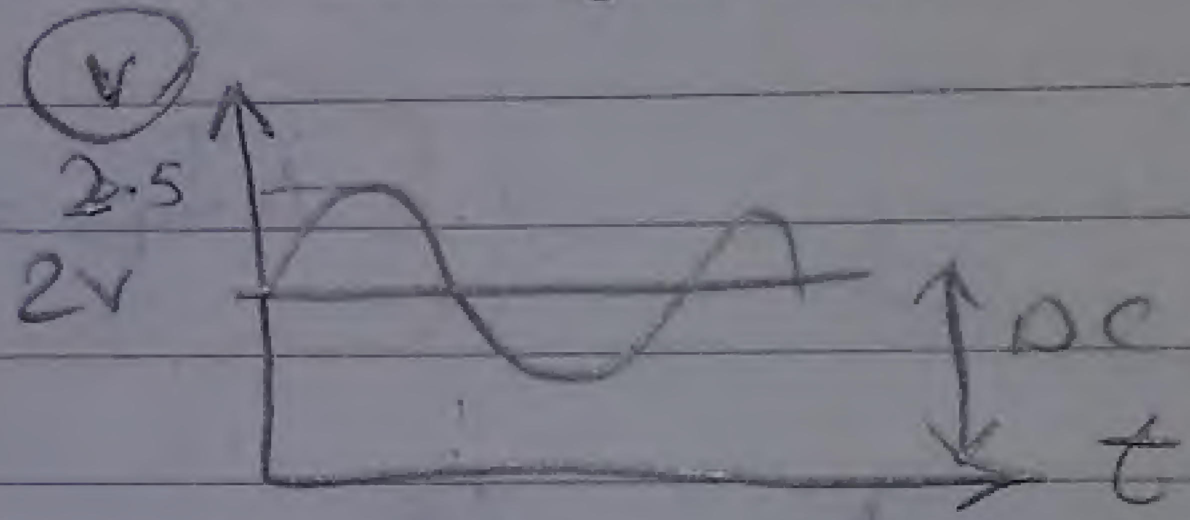
Hi. Star





rd = Small signal Model

ولكن لو كان rd
مش Small signal
∴ الحل لا يصلح



جهد متغير ولكن
Refrenle ≠ 0 = D.C

$V(t) = V_D + V_p \cos(\omega t)$ (D.C → V_D)

$\Rightarrow I_o = I_s \exp\left(\frac{V_o}{V_T}\right)$ ∴ $R_d = \frac{V_T}{I_o}$.

$I_p = (I_o / V_T)\, V_p$ $I_p = \frac{V_p}{R_d}$.

$\Rightarrow I_p(t) = I_o + I_p \cos \omega t$

$I_p = I_s \exp(V_o/V_T) + \frac{I_o}{V_T} V_p \cos \omega t$

تيار الدايود = تيار DC + تيار AC
صغير وممكن نهمله

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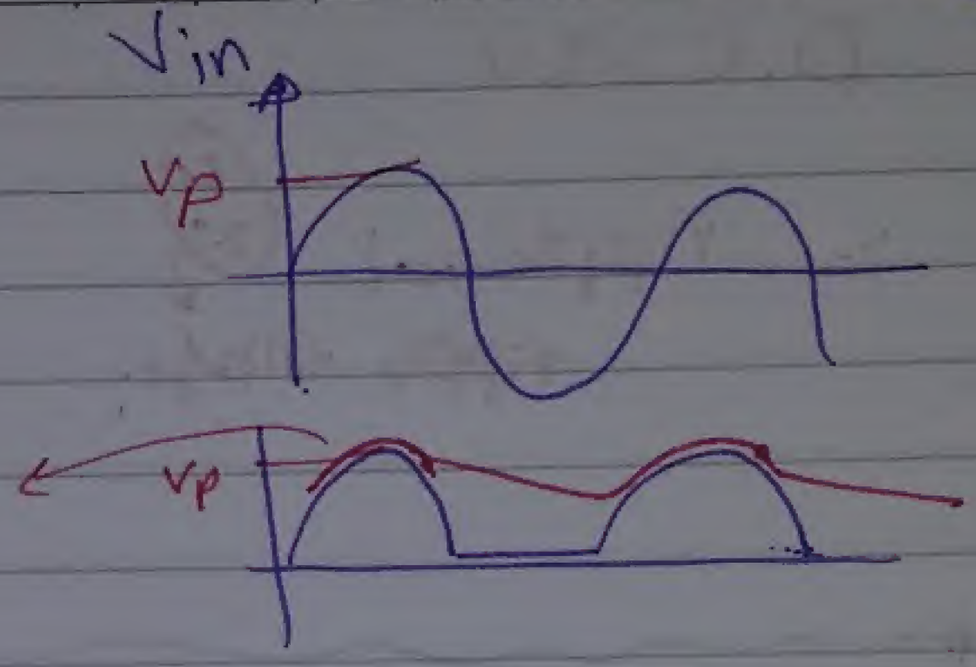
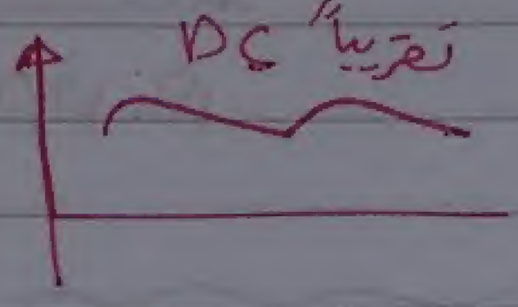
* Diode Application

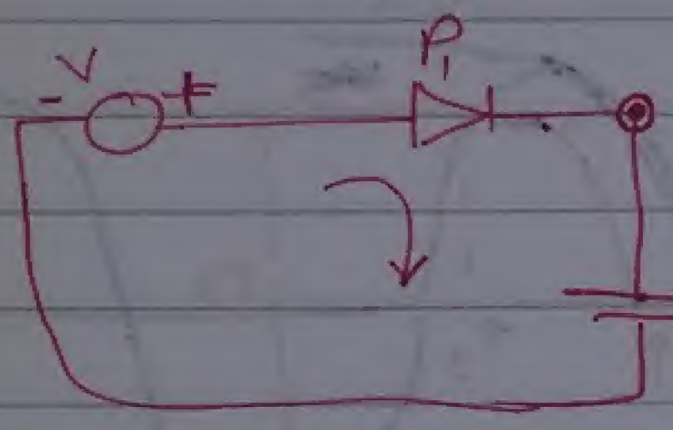
[1] Half Wave





الى بيعمل كده الكثف

$V_{DC} = .3 V_p$



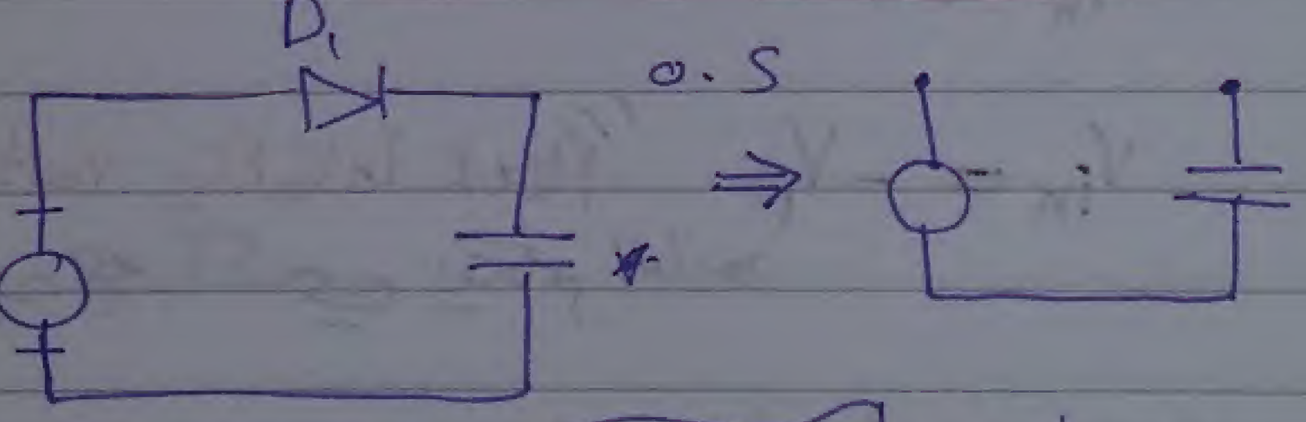
⇒ الكثف بيشحن لـ Vp لما

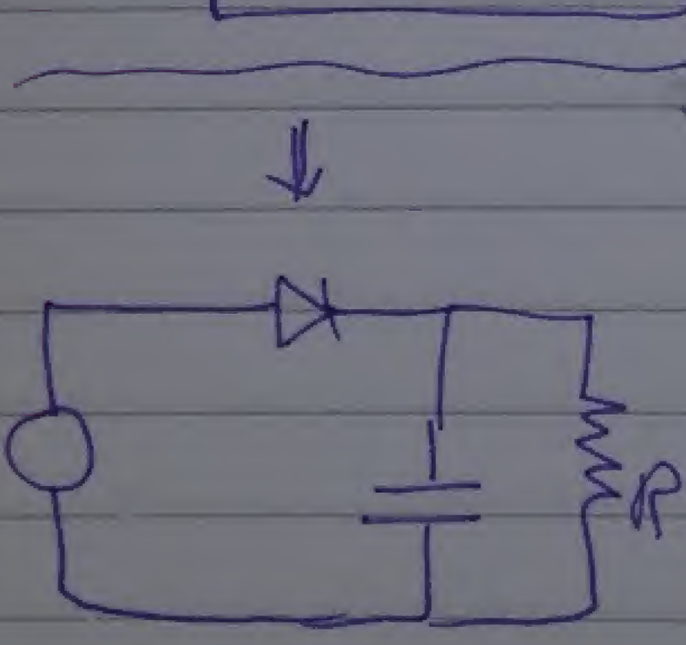
at $V_p = 0$ $V_{in} = V_C$

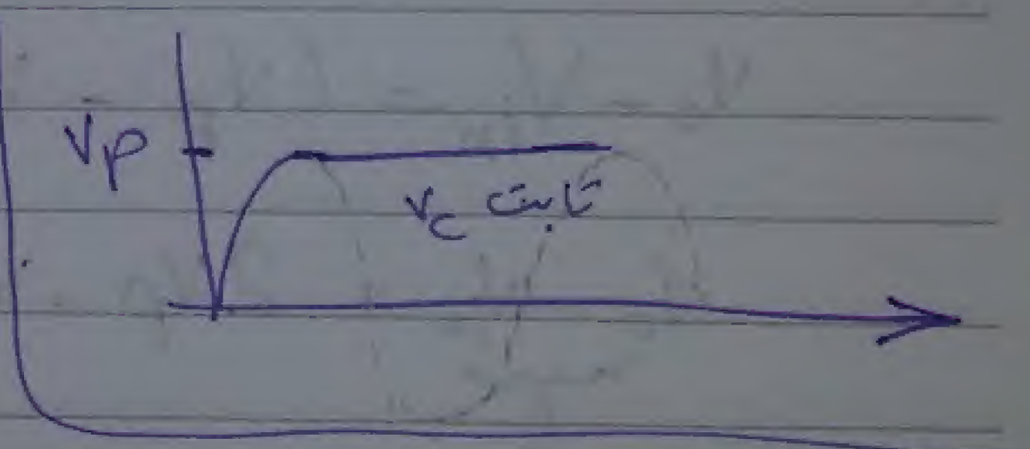
$V_p = V_C$

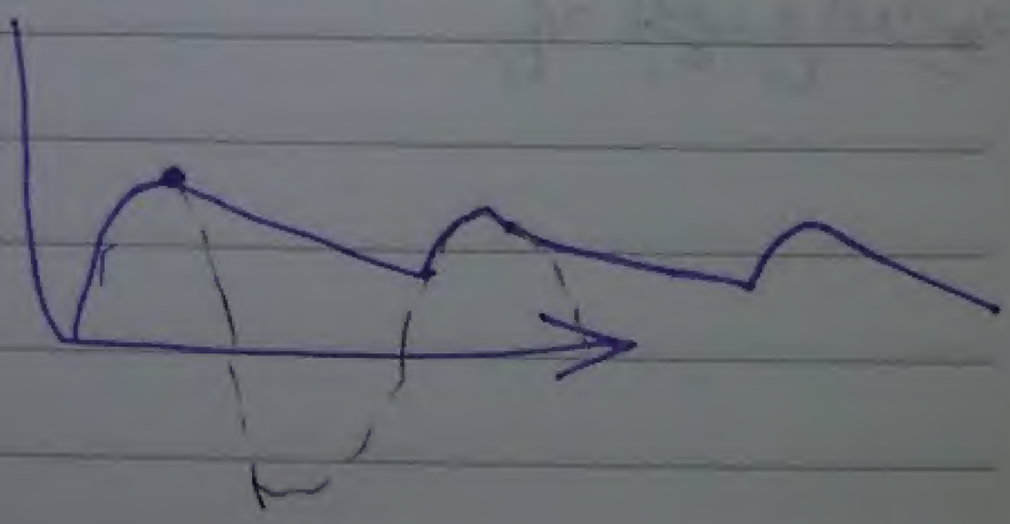
at $V_p = .6$

∴ الكثف هيشحن $V_p - .6 = V_C$









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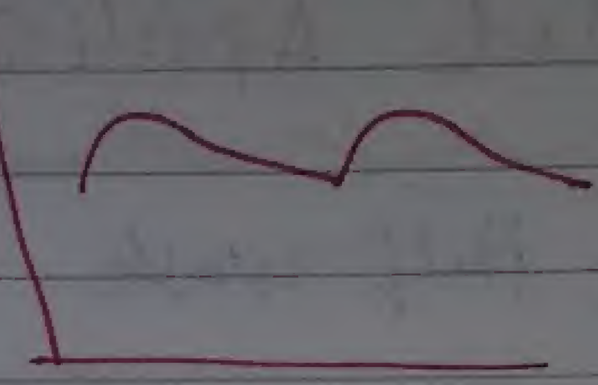
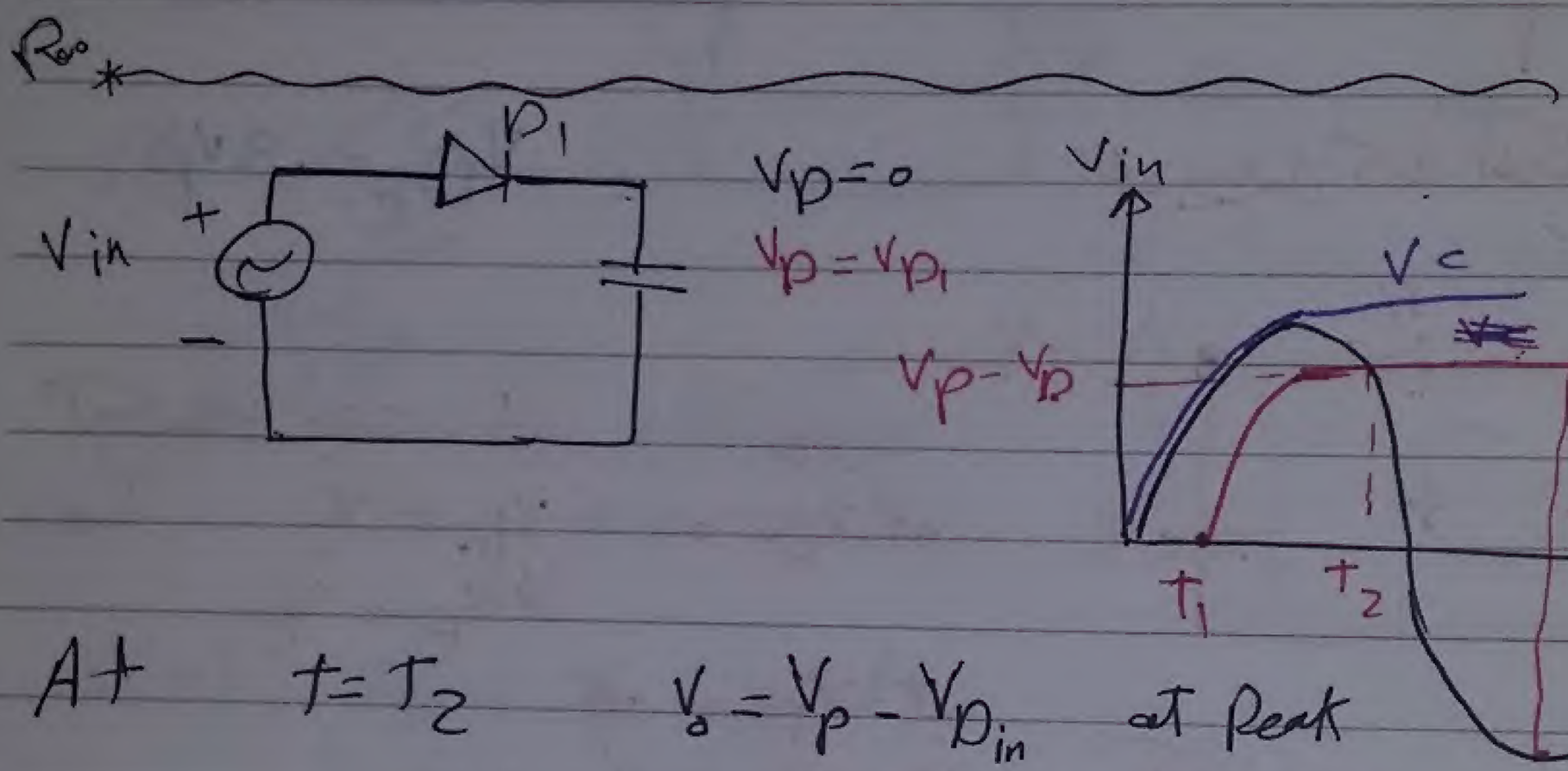
D.C = 3V

∴ ripple = 0.1 (3.1 / 2.9) ripple voltage.



Ripple voltage



At $t = T_2$ $V_o = V_p - V_{D_{in}}$ at Peak

$\Rightarrow$ $T > T_2$ $V_{in} < V_o$

$\Rightarrow$ $T = T_3$ $V_{in} = -V_p$ "Peak inverse voltage."
أقصى جهد عكسي يتحمل الدايود

$V_o - V_{in} = (V_p - V_{D_{in}}) + V_p$

$V_o - V_{in} = 2V_p - V_{D_{in}}$

V_D الجهد الدايود.